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EDITOR'S PAGE

Chronic Total Occlusion: A Job for the "Heart Team"

I am often asked to speak about the development of percutaneous coronary interventions (PCIs) and where they are projected to go in the future. When the subject turns to the frontiers in coronary interventions, chronic total occlusion (CTO) always takes center stage. In this issue of *JACC: Cardiovascular Interventions*, there are 3 articles and 1 editorial dealing with issues related to CTO (1–4). One is a group effort at proposing an algorithm for approaching CTO with the general concept of developing concentrated expertise in an organized approach to CTOs; another is a specialized technique for an antegrade approach to CTO intervention; and a third is reporting the survival benefit of successful CTO interventions compared to those that are unsuccessful. The editorial makes the case for attempting more CTOs and reflects on many observational studies that suggest improved survival with successful intervention on CTOs compared with unsuccessful intervention. We have recently published other papers aimed at improving our readership's prowess in dealing with CTOs. Several CTO clubs have sprung up in the United States, Japan, Europe, and other places because of the growing interest in this subset of coronary interventions. With so much interest, one wonders why such a small percentage of CTOs are undergoing attempted PCI. According to the latest guideline of the American College of Cardiology/American Heart Association/Society for Cardiovascular Angiography and Interventions, only 8% to 15% of patients with CTO undergo attempted PCI (5). The reasons usually proposed for this are the technical difficulty and modest success rate of CTO interventions, and the uncertainty of the clinical benefit.

As I read the editorial by Moses (4) (which is clearly from the perspective of a strong advocate for CTO intervention) and the article by Jones et al. (3), with dramatic survival benefit of successfully opened CTOs compared to those with failed attempts, I began to wonder if CTO intervention should continue to be called the "unconquered frontier" or if in fact its value has been well demonstrated. If this is true, why is the latest guideline more reserved? The up-to-date guideline states, "studies suggest that patients who undergo successful, rather than failed, recanalization of CTOs fair better in terms of symptom status and need for CABG, as well as LV function. However, the impact of successful CTO recanalization on long-term survival remains unsettled" (5). At this point in my dilemma, I flipped back to the editorial by Moses (4), which cites a number of observational studies in patients with successful CTO interventions. I was interested to find that the earliest large series came from our own institution, Emory University Hospital (6). All of the CTOs we treated between 1980 and 1988 with plain balloon angioplasty were reviewed. Although comparing trials is fraught with error, I was surprised to rediscover that the success rate in those dark ages was 66% compared to the 69.6% success rate in the study by Jones et al. (3), which occurred between 2003 and 2010. The follow-up duration was similar in both trials and both showed a similar odds ratio for mortality favoring the successfully treated group; 1980 to 1988 study, odds ratio 0.21 (95% confidence interval: 0.05 to 0.83) and 2003 to 2010 cohort, odds ratio 0.28 (95% confidence interval: 0.15 to 0.52). Have we missed the clear-cut benefit of opening CTOs for the past almost 30 years, or does the lack of embrace of a survival benefit reflect something else? There are several suggested mechanisms by which revascularizing totally occluded arteries could contribute to a survival benefit, including decreased ischemia and arrhythmogenicity and improved left ventricular function. The survival benefit, however, seems to far exceed the survival benefit for patients with stable ischemic heart

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The impact of successful CTO recanalization on long-term survival remains unsettled.

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disease undergoing PCI overall. Another explanation might be selection bias whereby patients with failed CTO attempts in fact are sicker with more comorbidity. Another, and more disturbing, possibility is that the failed attempts at opening CTOs actually result in harm. One would expect this effect to be primarily early and a lack of high-hospital mortality in these trials would argue against that occurring. If the mechanistic explanation for improved survival with CTO revascularization holds true, then should we not take advantage of all means to provide revascularization for these patients? In the Emory University trial, many of the patients who were unsuccessfully recanalized with a PCI underwent subsequent bypass surgery. If we believe that recanalization of total occlusions provides such a potent survival benefit, 5-year mortality 4.5% for successful PCI versus 17.2% for failure in the Jones et al. (3) observation, then failure should not be allowed. If the mechanism of survival is related to the revascularization of the artery then, when PCI is not possible, surgery should be done. If this thesis is correct, then perhaps the surgical consideration should come up front with the convening of the "heart team" to consider what approach would be best for each individual patient with CTO. The aforementioned guideline states, "consultation with a cardiothoracic surgeon and use of the heart team approach in cases of CTO in which a large territory is subtended and/or multivessel CAD is present are frequently done" (5). Well, I do not know how frequently it is done, but with so much hanging in the balance, should that be routinely done? The conclusion from the editorial (4) differs from the guideline in suggesting that PCI should, in addition to symptomatic patients, be a reasonable approach for those with >10% ischemia, those with multivessel disease, and those who need improvement in left ventricular function. The authors of the papers and the editorial all admit that the evidence for these claims is lacking and is sorely needed. After 35 years we still do not know if revascularization of CTOs results in improved survival. A randomized trial is referenced which will study patients with stable angina assigned to optimal medical therapy or PCI and followed for 36 months (7). Since the leading cause for referral to surgery instead of PCI remains the presence of CTO, would it not be reasonable to perform a randomized trial of revascularization with PCI or coronary artery bypass grafting (CABG) compared to optimal medical therapy in patients with manageable stable ischemic heart disease? Such a trial could involve the heart team from the outset, as was used in the SYNTAX (Synergy Between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery) trial. Patients with a projected high failure rate with PCI could be referred directly for CABG, and patients with unsuccessful PCI could subsequently undergo CABG. The improved technical prowess reflected by the papers in this issue combined with surgery in the remnant of patients in whom that is not possible could go a long way to finally answering the question—should CTOs be opened to prolonged survival?

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